Dispatching method of incoming events for ERP system based on analysis of emails using artificial intelligent technique

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Abstract. The article describes a method for solving automatic dispatching problem of incoming events in ERP systems received from incoming emails via external mail programs by using artificial intelligent processing. Realization include recognition of client appeal subject, selecting key information and transferring it to enterprise business processes through creation of tasks. In this research, was developed program module for ERP system based on "1C: Enterprise" platform and integrated with an external mail application and neural network oriented to natural language recognition. As a result, it made possible to embed that mechanism into business processes engine of the information system and solve the problem in practice.

1. Introduction

Effective operating of a modern enterprise is impossible without well-designed automation of its business processes. Especially in the context of rapid increase processed information volume, when companies use various information resources, corporate databases, application and office software. Therefore, management should affect as many business processes as possible and cover the entire company as a whole. [1]

This is most relevant for industrial enterprises due to large number of technological processes and its complexity. For this purpose, there are used ERP systems (Enterprise Resource Planning) which provide automating not only production, but business processes related to the budget, finance, tax, human management and others spheres. In common case ERP system provide common information space, where all departments and divisions of the company can collaborate with each other.

The most popular ERP systems used in Russia are based on platform called "1C Enterprise" [2]. It is mainly caused by the fact that native systems fully correspond with accounting activities and regulated reporting standards for the Russian federation.

Nowadays there are two concepts are implemented in aforementioned automation systems: BMP (Business Process Management) and workflow, which are interrelated. [3]

Within these approaches, the "1C: Enterprise" platform contains a built-in business process engine. It gives tools to describes sequence of related operations directed to obtain overall result, given the organizational structure of the enterprise and functional roles. Each separate operation is a specific task for a suitable user. As a result of its execution business process are moved.

Using tasks, you can ensure the movement only of business processes in a company which are structured and rules for its execution are logically described. Such automation gives possibility to identify and trace states of business processes at any time. In addition, it assists to maintain order,

reasonably allocate time and efforts, eliminates multiple human errors, and increases motivation of staff for work.
In general, the following goals are achieved when applying the business processes engine:

- Efficient notification of staff about incoming new task.
- Organization of employees working process.
- Workflow management.
- Coordination of work between departments.

Various business processes connected with sales, service, logistics, marketing, analytical service, quality service and others fields are implemented on that basis inside application solution named "1C: ERP Enterprise Management". In particular, the management of sales process based on transactions with clients, human resources tasks, payroll tasks and etc.
The initialization of a business process is usually preceded by some initial signal. It can be a customer order received from online store, an email request, a phone call, or another dependent business process.
Therefore, the integration of an enterprise automated system with any communication sources is one of the most important task. This reduces the loss of information, speeds up the interaction between executors and increases the overall managing ability of the enterprise.
Today e-mail corresponding is one of the main textual communication means in business. [4] Using it to obtain initial data, we can flexibly manage all existing business processes in an enterprise. For integration can be designed the built-in mail manager or used an external mail program. After data retrieving dispatching task appears. In other words, distribution of incoming events, which is currently implemented manually. Taking into account increasing number of incoming email letters this is considered as vital task.
In our work, we describe a method for solving this problem using processing of data received from incoming emails via external mail program. Realization include recognition of client appeal subject, selecting key information and transferring it to enterprise business processes using automatic creation of tasks.

2. Methodology

In general, the algorithm includes the following actions. New task will be created when a request is received. At the same time the system recognizes the client by contact information. It also detects the subject of his appeal using artificial intelligent and looks for any connections with previous appeals by references to common tasks, documents and other processes or projects. Finally, the program determines a role of supposed executor and dispatch the task to the right employee.
State the main functions of the system:

- Analysis of incoming e-mail during interacting with customers, suppliers and partners.
- Finding relations with previous unfinished tasks within one business process.
- Automatic creation and distribution of tasks among executors.
- Additing a new objects and documents inside ERP systems and attaching them to the task.
- Determination of key appeals parameters and link them to the task
- Make possible to view full text of appeal and respond to it through external email program.

To solve the specified problem, three software components are used: 1) email processing unit, 2) a natural human language recognition module and 3) a program part of ERP system integrated into the enterprise workflow engine. The concept of their interaction you can see in Figure 1.
Email processing unit is an application program that provides data from user emails. In our case, we used MS Outlook client connected though COM object to the ERP system. This is only one of the connection methods, we also can connect directly to email server using POP3 or IMAP protocols. The main specialization of it is to receive email content.

Natural language understanding is a modern branch of artificial intelligence which is widely used today for analysis of human's writings [5].

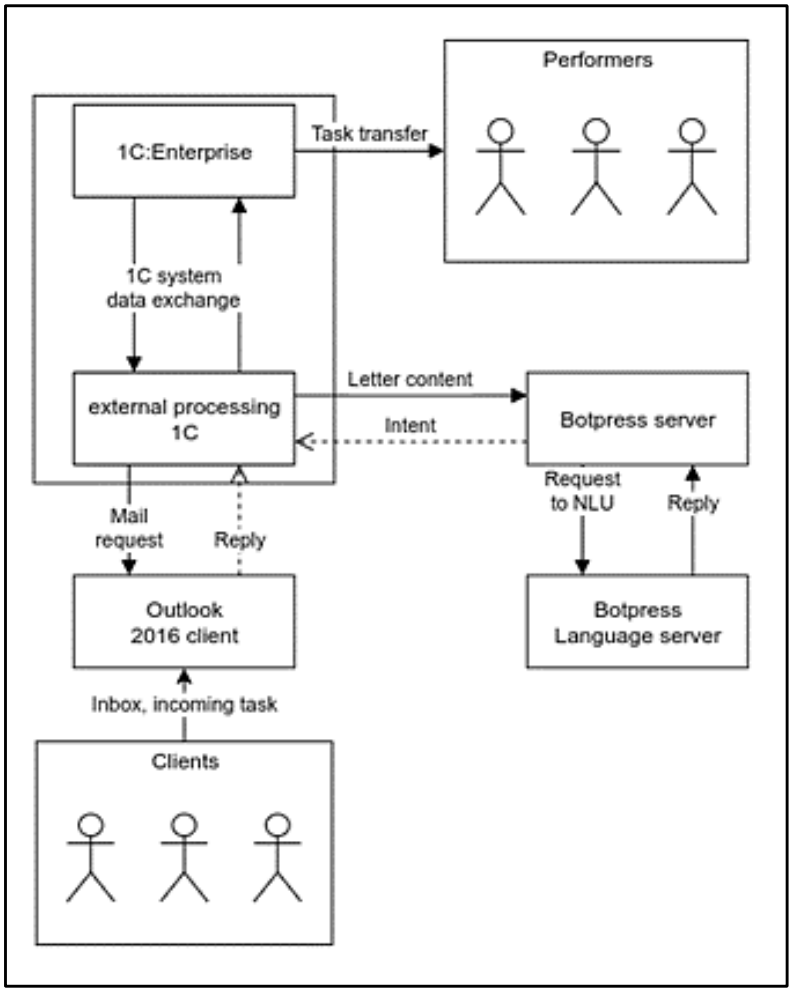


Figure 1. The interaction diagram of the incoming events dispatching system components.

So to resolve recognizing task of appeal subject we applied a platform named Botpress based on neural networks. It is mainly focused on natural language recognition and intended for building chat-bot systems. The platform meets two main selection criteria: 1) it supports the Russian language and has ability to deploy as a local web service. This module analyses the email text and determines main point of it with key parameters as well.

Special processing module has been developed for application solution "1C: ERP Enterprise Management". It connects to both of mentioned modules and receives useful data from them. This data necessary for finding relations, as well as for creation and distribution of tasks according to the role division of users. This module is also embedded into notification mechanism whereby users can get tasks in time.

3. Realization

For the right operating of the system are required the following installed software: 1) Microsoft Outlook 2016; 2) Application solution "1C: ERP Enterprise Management" 3) Botpress server with language model.

Microsoft Outlook must be configured to receive email to a specific address. In order for the Botpress platform might function with data locally, we need to install a server with a language model. The

server has several modes of operation. The command “bp lang --offline --dim 300 --langDir .\langs” starts the server in offline mode with language model located in the “langs” directory and number of language model dimensions is 300. Parameter languageSources.endpoint in configuration file data/global/config/nlu.json has been set as "http://localhost:3100". Therefore, Botpress platform can connect to a local language server available on the port 3100.
The process of creation and training a neural network is realized through the interface of a web application, without using of programming skills.
From certain categories of business processes "1C: ERP Enterprise Management", we have identified some of necessary intentions and purposes of appeals, which shown in table 1.

Table 1. Some of appeal intentions for purposes of recognition by neural network.

Intent name	Definition
Sales management	
applicationforpayment	Request for payment
clientorder	Create a client order
getprice	Price offer, check prices
contractagreement	Negotiation about a contract
Document Management	
bankdocument	Bank document, bills
supplementaryagreement	Additional agreement for a contract
getaget	Company partner request
Procurement activity	
getdiscount	Business proposal approval
delivery	Delivery management
invoice	Confirm invoice
Customer service	
warrantycase	Warranty case
getdocumentation	Additional documentation
processcustomerrequest	Customer request
Warehouse management	
goodsmovementorder	Goods movement warrant
productacceptance	To acknowledge the receipt of getting goods
productavailability	Goods availability request

Next, it is necessary to create a new robot in the client side of Botpress and configure it in NLU section. Then client's intentions have been created on the “Intens” tab listed in Table 1. For each intention, you must specify as many statements as possible. The platform trains neural network on the received examples and will be able to operate with real data.
Figure 2 shows an example of training the neural network for “Processing of a customer order” intent [6]. The “clientorder” intent is selected in the left panel. The central pane contains statements related to the current intent. And the right pane contains entities or key parameters, such as a list of products, order number, etc. The system automatically calculates the number of required examples to display relevant information. It is desirable to use a variety of real examples to increase precision of recognition. The platform extract important information from text and keep it in entities. Which is used for the further automatic filling of documents and determining relations with other objects in ERP system. For example, it can be nomenclature and its quantity.
Client applications exchange information with the Botpress server through HTTP requests. The server returns a JSON string of a specific structure that can be processed in a special unit of ERP system.

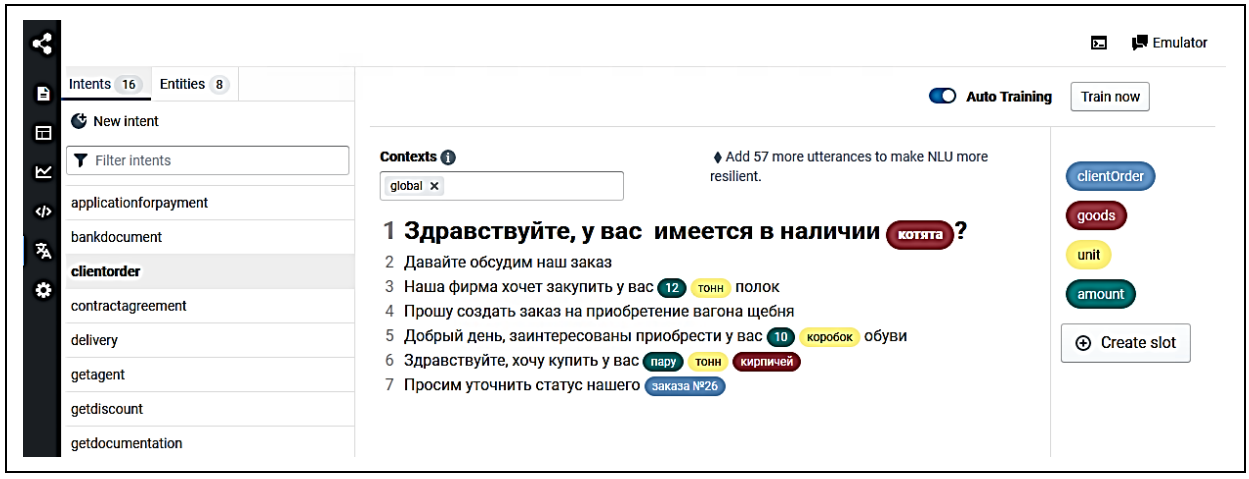
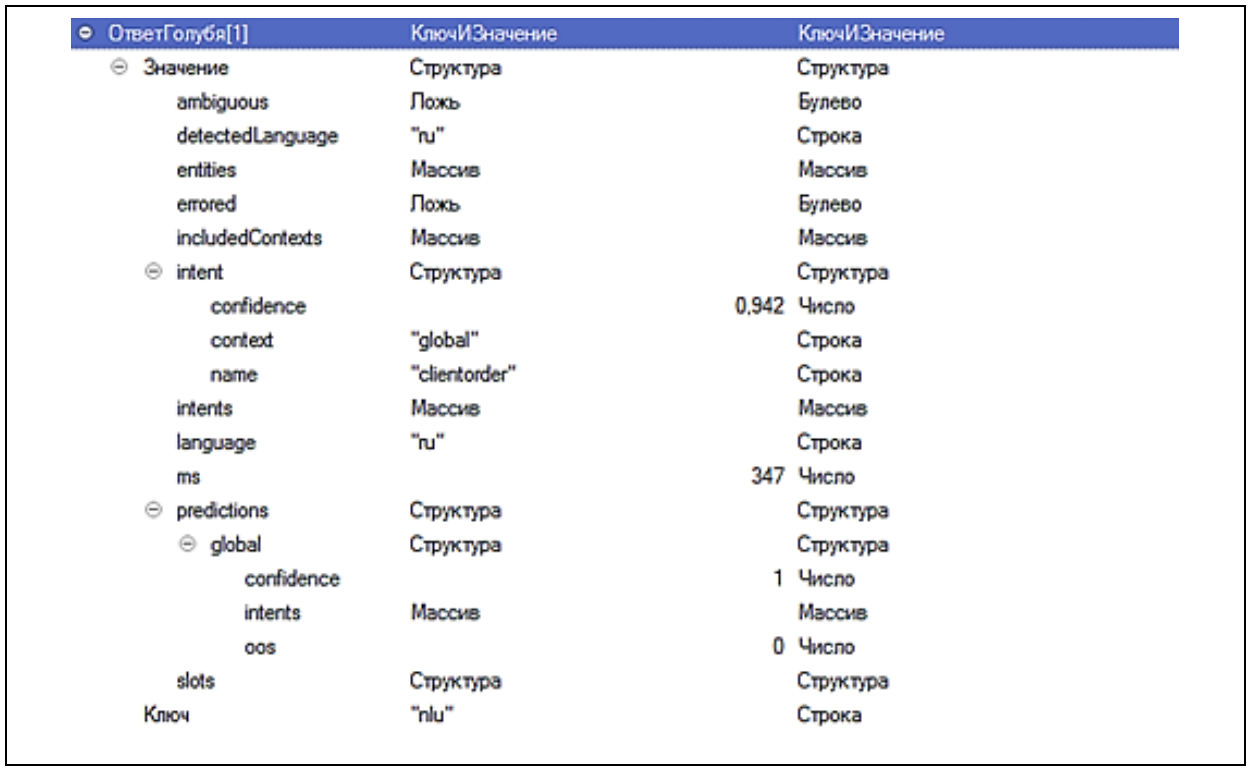


Figure 2. Example of training neural network on Botpress platform

Figure 3 shows an example of the resulting structure, where the “intent” property contains a list of the most relevant intents with the highest matching index. The “intents” property includes array with all possible intentions. If the neural network can recognize any entities, they will be represented in the “slots” structure.



ОтветГолубя[1]	КлючИЗначение	КлючИЗначение
Значение	Структура	Структура
ambiguous	Ложь	Булево
detectedLanguage	"ru"	Строка
entities	Массив	Массив
errored	Ложь	Булево
includedContexts	Массив	Массив
intent	Структура	Структура
confidence	0,942	Число
context	"global"	Строка
name	"clientorder"	Строка
intents	Массив	Массив
language	"ru"	Строка
ms	347	Число
predictions	Структура	Структура
global	Структура	Структура
confidence	1	Число
intents	Массив	Массив
oos	0	Число
slots	Структура	Структура
Ключ	"nlu"	Строка

Figure 3. Resulting structure retrieved by Botpress server for “clientorder” intent

A special external processing unit was created using development framework ”1C: Enterprise”. It receives and process source data from MS Outlook, sends it to Botpress server and based on the results creates tasks for users according to their roles. Thus, it builds in enterprise's business processes engine. On the Figure 4 we can see several incoming emails and recognized appeal subject of one of them as a result of neural network processing.

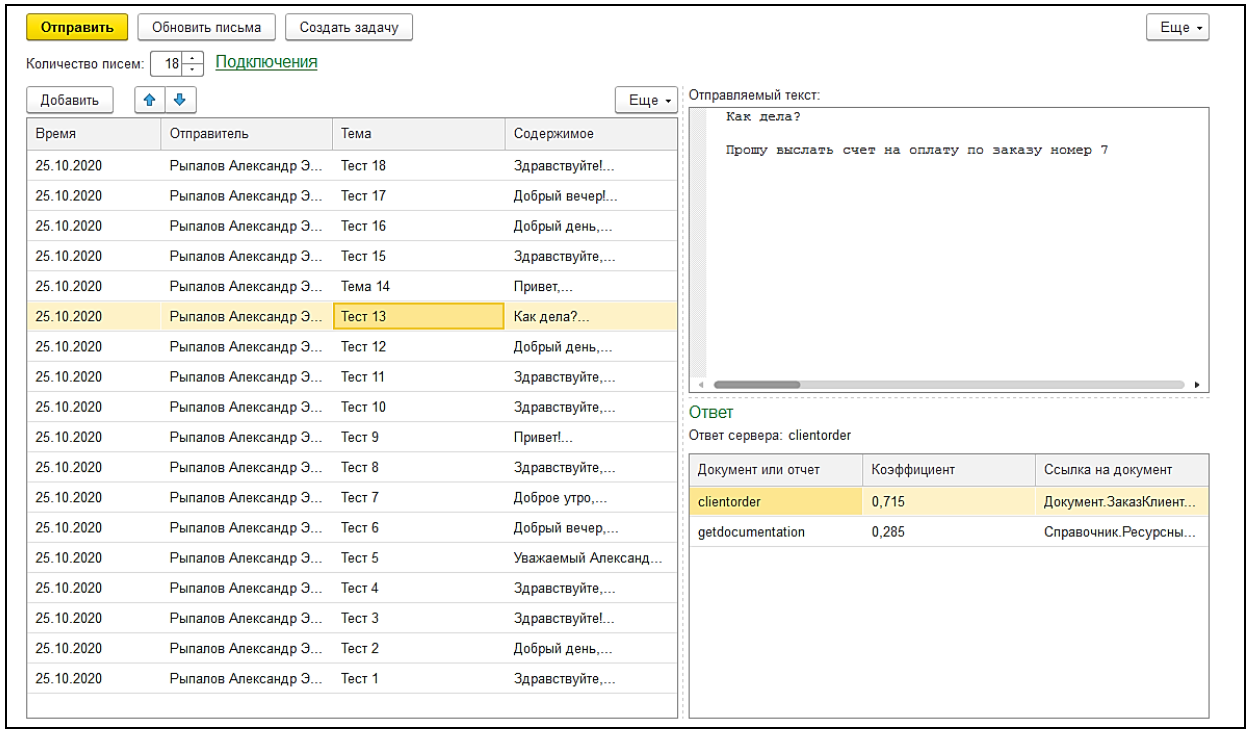


Figure 4. Interface of the developed dispatching unit at the stage of getting recognition results.

Consider a realization of algorithms. Receiving email correspondence is implemented by using a COM object. Program code is depicted on the Figure 5.

```
Outlook = New COMObject("Outlook.Application");
NameSpace = Outlook.GetNamespace("MAPI");
FolderInbox = NameSpace.GetDefaultFolder(6);
For Counter = 1 To NumberOfLetters Do
    Message = FolderInbox.Items(Counter);
    Line = ListOfLetters.Add();
    Line.Date = Message.ReceivedTime;
    Line.Theme = Message.ConversationTopic;
    Line. SenderName = Message.SenderName;
    Line.Body = Message.Body;
EndDo;
```

Figure 5. Part of algorithm of getting source data from emails

The text of received email is sent to the Botpress server by POST request. A received answer is processed and further used for creation and dispatching tasks for executors in compliance with the identified intent. Corresponding functions are on the Figure 6 and Figure 7.

```
Answer = SendText(LetterContent, Token);

&AtClient
Function SendText(Text, Token)
    ResourceAddress = "/api/v1/bots/pidgin/converse/userId/secured?include=nlu";
    Data = New Structure("type,text", "text", Text);
    RequestBody = FormattingSturctureBJSON(Data);
    Return MakePOSTRequest(ResourceAddress, RequestBody, Token);
EndFunction
```

Figure 6. Functions of sending data from the system to Botpress platform

```
&AtClient
Function MakePOSTRequest(ResourceAddress, RequestBody, Token = "",
    Server = "localhost:3000")
    Connection = New HTTPConnection(Server);
    Request = New HTTPRequest(ResourceAddress);
    Request.Headers.Insert("Content-type", "application/json; charset=utf-8");
    Request.SetBodyFromString(RequestBody);

    If NOT Token = "" Then
        Request.Headers.Insert("Authorization","Bearer " + Token);
    EndIF;

    Answer = Connection.CallHTTPMethod("POST", Request);
    Stream = Answer.GetBodyAsStream();
    Encoding = "utf-8";

    Reader = New JSONReader;
    Reader.OpenStream(Stream, Encoding);
    Result = ReadJSON(Reader);
    Reader.Close();
    Return Result;

EndFunction
```

Figure 7. Functions of data receiving by the system from Botpress platform

4. Results

Experimental testing of the system was carried out on samples of emails, from the company's business correspondence and comparative table 2 was compiled. It contains text of various appeals and results of neural network's work in the form of a recognized intent with the matching index.

Table 2. Summary table of client appeals and recognition results.

Text in email **Target result**	**Response/Coefficient**	**Second response/Coefficient**
Send please an invoice for the products specified in the attachment *invoice*	*invoice*/0,718	*applicationforpayment*/0,282
The shelf of the rack is cracked, you have to move the item from bin 3 to another bin goodsmovementorder	*Goodsmovementorder*/0,94	*Delivery*/0,06
Please give the prices for products including delivery to the of Chelyabinsk *getprice*	*Getprice*/0,733	*Delivery*/0,256
Send please technical documentation and specification for indicated items in the attachment *getdocumentation*	*Getdocumentation*/0,891	*applicationforpayment*/0,109
Taking into account the difficulties encountered, please provide a discount for the order *getdiscount*	*None*/0,976	*Clientorder*/0,024
For further acceptance of the goods, please send your employee *getagent*	*Getagent*/0,944	*Clientorder*/0,056
The documentation on the contract has been studied, we are ready to sign it *contractagreement*	*None*/0,995	*Contractagreement*/0,005
Payment receipt is ready and is attached to this letter *bankdocument*	*None*/0,996	*Clientorder*/0,004
We would like to discuss the possibility of delivering to Moscow *delivery*	*Delivery*/0,914	*Clientorder*/0,086

We want to order Toshiba TVs from your company at a price of 24,000 rubles. Please provide an invoice for the payment		
clientorder	*Clientorder*/0,896	*Getprice*/0,131
Please send an invoice for payment for order number 7		
applicationforpayment	*Clientorder*/0,745	*Getdocumentation*/0,255
I will pass client's appeal to you, there was a problem with the number of parts during the assembling		
processcustomerrequest	*None*/0,997	*Productacceptance*/0,003
There were identified a problems during acceptance of the products and shipped goods did not match techical conditions		
productacceptance	*Productacceptance*/0,549	*Getdocumentation*/0,451
We want to know the assortment of your goods. Can you ship out such a volume?		
productavailability	*Delivery*/0,552	*Productavailability*/0,448
Long-term cooperation with you let us to offer a new supplementary agreement		
supplementaryagreement	*Supplementaryagreement*/0,92	*Clientorder*/0,078
The "Victory" vacuum cleaner has broken. The control panel are stopped working. Is it a warranty case?		
warrantycase	*Warrantycase*/0,804	*Clientorder*/0,196

Based on the obtained results, we can conclude that number of correctly defined intentions is 62.5% (10 correct cases against 16). If take into account situations where the correct intention was detected as alternative, then 75% of the tests were successful. Considering the fact that during training of the neural network a limited set of statements was used (in average, about 4 examples were provided for each intention) the obtained result can be considered as positive.

5. Conclusion

In the described work, we have integrated an ERP system based on "1C: Enterprise" platform with external mail program and neural network oriented to natural language recognition. As a result, it made possible to embed in the business processes engine and solve the problem of automatic distribution of incoming events received by e-mail among users in practice.

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